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AUTHOR Veldman, Donald J.; Menaker, Shirley L.
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ABSTRACT

Public school counselors and psychologists can expect valuable assistance from computer-based assessment and counseling techniques within a few years, as programs now under development become generally available for the typical computers now used by schools for grade-reporting and class-scheduling. Although routine information-giving and gathering interviews can be computerized with relative efficiency, the future of computer-based therapeutic counseling appears gloomy. Computer programs provide rational information upon rational demand, and can even use rational methods to determine the information needed. When it comes to the irrational, intuitive, and emotional demands of therapeutic interaction, however, the machine is less effective than the human interviewer. Computers have not yet been programmed to reason by analogy, to sense subtle visual and auditory cues to emotion, or to feel empathically in a way that leads to understanding. They probably never will. A variety of current research efforts are reviewed. (Author)

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COMPUTER APPLICATIONS IN ASSESSMENT AND COUNSELING

Donald J. Veldman and Shirley L. Menaker

Public school counselors and psychologists can expect valuable assistance from computer-based assessment and counseling techniques within a few years, as programs now under development become generally available for the typical computers now used by schools for grade-reporting and class-scheduling. Although routine information-giving and gathering interviews can be computerized with relative efficiency, the future of computer-based therapeutic counseling appears gloomy. A variety of current research efforts are reviewed.

What can the practicing counselor/psychologist in a public school expect from recent developments in computer applications, with regard to two of his most time-consuming routine functions: psychological assessment and academic-vocational counseling? In this article a variety of recent developments in these areas will be described, and attempts will be made to extrapolate their practical impact on the activities of school psychologists and counselors in the near future.

Although employment of computers to calculate test scores and to carry out statistical summaries and analyses of test data has been common for many years, the extension of these methods to encompass more than multiple-choice questionnaires has been a relatively recent development. The difficulties involved in analyzing verbal data are not nearly so much with adapting the data to the demands of computer systems, as in translating the vague and incomplete descriptions of clinical content analysis into fully objective procedural rules suitable for computer programming.

On the other hand, almost no consideration was given to the possibility of using a computer to carry out routine academic and vocational counseling processes with students until the very recent introduction of time-shared computer hardware which links two dozen or more terminals to a single central processor. These systems, as described elsewhere in this issue, are the basis for the rapid development of Computer-Assisted Instruction (CAI), and the natural extension of their capabilities to include testing and interviewing functions is advancing rapidly.

Therapeutic counseling by computer programs has not gone far beyond

Donald J. Veldman is Associate Professor of Educational Psychology at the University of Texas at Austin, and is Director of Research Methodology and Data Processing for the R & D Center for Teacher Education. He received his BA degree from Hope College in 1953, and his PhD from the University of Texas in 1960. He has authored two books and numerous articles in the fields of statistics, computer techniques, and personality assessment.

Shirley L. Menaker is Assistant Professor of Educational Psychology at the University of Texas at Austin, and Research Associate with the R & D Center for Teacher Education. She received her BA degree from Swarthmore College in 1956, and her MA and PhD degrees from Boston University in 1961 and 1965, respectively. Her publications have been in the fields of child development and personality assessment.

a few startling, but somehow discouraging, demonstrations of what a computer can be programmed to do. The results of these studies are startling when the program *appears* to be successful at interpreting what the human client says, but the infrequency of such successes and the obvious dull rigidity of such "therapeutic" programs suggests a rather gloomy outlook for the future of such applications.

After reviewing the work published to date in these three areas—assessment, counseling, and therapy—we will attempt to draw them together to extrapolate a vision of the manner in which a future counselor/psychologist might use a comprehensive computer system to assist him in his routine activities.

Test Report Generators

For some time, computers have been used to compile scores from multiple-choice questionnaires and to produce profiles of scores across a number of scales. Recently, the contribution of the computer has been enlarged to include the generation of test reports from such data. These reports are most successful (if success is seen as matching the judgments of a clinical rater) when the test data permit an interpretive statement to be tied directly to a given score. The more the interpretation of a score depends on its context (within a total set of scores), the more the computer must give way to the clinician's efficiency.

Helm (1965) has programmed the evaluation of test profiles from a comprehensive biographical inventory; several aptitude, temperament, and ability measures; and a work attitudes inventory, among others. Using summary paragraphs written by psychologists who had evaluated much of the same data, 65 classes of sentences were evolved which covered close to 90% of the information in the paragraphs. Then, simple sentences were designed as direct translations of given scores (e.g., "He has above average general verbal ability"), and compound sentences were also included to reflect a contrast or similarity between two or more particular sets of scores in the profile.

In a somewhat similar manner, a model of a counselor's decision rules, in appraising a student's cumulative folder prior to a planning interview, was defined by Cogswell and Estavan (1965). The appraisal program accepted as input the data from the folder (grades, aptitude test scores, parents' occupations, etc.), applied the programmed "rules" abstracted from the counselor's judgments, and selected an appropriate output statement such as the following: "Student's grades have gone down quite a bit. Ask about this in interview. Possibly there are personal problems." No significant differences were found between the appraisal behavior of two counselors and the computer output on 75% of the statements. Humans and the computer performed similarly in terms of identifying changes in the pattern of student's grades, underachievement, overambitions, appropriate and inappropriate post high school plans, but the computer program was somewhat more pessimistic in predicting the future achievement of students in the lower aptitude levels.

Moving into a more psychodiagnostic area, Kleinmuntz (1963) simu-

lated the profile analysis of an interpreter of the Minnesota Multiphasic Personality Inventory (MMPI). He spent approximately 30 hours listening while an expert clinician verbalized his "rules" for sorting 126 test profiles into two groups: adjusted and maladjusted. From analysis of these verbal data, 35 rules were eventually generated and the sorting task was simulated on a computer, which eventually performed better than the expert with a new sample of cases.

In a more extensive project with the MMPI, Swenson and his colleagues (1965) developed a series of behavioral descriptive statements which were felt (by a large number of expert interpreters) to characterize various types of elevations or depressions of each of the MMPI scales. Descriptive paragraphs were then developed from these statements, one paragraph for each of five levels of the basic scales. In addition, there were more complex statements resulting from compound rules which went into effect for certain specified configurations or patterns of scale elevations. This technique has been further developed by a number of investigators, and a similar scoring service for the MMPI is being offered commercially by the Roche Psychiatric Service Institute. Similar scoring and reporting programs have also been developed for Gough's California Psychological Inventory (Finney, 1967) and for Cattell's 16 Personality Factors Inventory (Eber, 1965).

Piotrowski (1964) initiated the development of computer interpretation of Rorschach data. In his system, the Rorschach variables (color, form, movement, etc.) are scored by human clinical scorers. (For scoring of inkblot variables by computer, see the article by Ross elsewhere in this issue.) The input to the computer program consists of these scored variables, and the program embodies interpretive rules regarding their levels. If the necessary antecedents are available in the record, the computer types out the programmed "consequent" in its report. At the present stage of processing, the reports which are output contain many redundancies as well as many internal inconsistencies, which are the major focus of current work on the system.

As indicated above, relatively efficient procedures are now available for producing readable summaries from a wide variety of instruments. While some of the programs involve limited branching operations, most of them do not go beyond the use of highly objective decision rules for selecting simple output statements. In this sense, the programs do not *interpret* the test data but only *translate* the results from numerical to verbal terms.

Content Analysis of Verbal Data

In contrast to the rapid progress in developing computer programs which score questionnaire data and/or translate numerical score profiles into verbal summaries, only a few research and development programs have been concerned with automated interpretation of verbal protocols which result from sentence completion instruments, story-telling tasks, or interviews. Although the problems of interpreting natural language data are far more complex than those involved in the translation of score profiles, the

potential applications are far more significant for the eventual construction of programs that really act like professional psychologists. The best of the present systems seem to operate at the level of a competent but rather rigid psychometrician.

Standing virtually alone in the field of computer-based content analysis is the *General Inquirer* system developed by Philip J. Stone and his colleagues at Harvard University. Marshall Smith describes some applications of this system elsewhere in this issue, and interested readers will find a complete description in a recent book (Stone, 1966). Using special "dictionaries" of words precategorized for particular research purposes, the system automatically tallies frequencies of category usage for a body of text. The materials which have been analyzed range from suicide notes to Thematic Apperception Test narratives.

Although some attempts have been made to deal with the problem of syntax by precoding the text word by word, most applications of the *General Inquirer* have simply ignored this aspect of the data altogether. Goldberg (1967), for instance, applied the system to sentence completions with some success. Other workers in the field of automated content analysis have sought to evade syntax problems by restricting the responses of the subject in one manner or another. Gorham (1967), for example, in developing a computer-based system for scoring responses to the Holtzman Ink-blot Test, restricted subjects to the use of six words for each blot. Even so, the system yields scores from group administration which are equivalent to those obtained by individual adminstration by trained examiners.

The authors of the present review, in collaboration with Robert F. Peck, have been engaged since 1962 in developing computer-based systems for scoring sentence completion data. Our compromise with the syntax problem was to restrict the subject to a single word in response to each stem. The first version of the system yielded 25 scores from a 90-item form by use of a dictionary containing 4,366 common response words (Peck, Menaker, & Veldman, 1966; Menaker, Veldman, & Peck, 1966). The most recent system produces 40 scores from a 36-item form and employs a complex word-root data reduction system, which utilizes 98% of the variety of words subjects use as responses. A recent book (Veldman, 1967a) describes some of the basic programming techniques used in studies of this type.

The common responses of a large sample of freshman college students were used also by Veldman (1967b) to construct a program which presented subjects at a time-shared computer terminal with sentence completion stems, and then responded differentially to their replies with further questions. Although this demonstration was quite superficial, it might serve as a prototype of future programs which could conduct intensive assessment interviews.

Another type of research in this area involves the use of empirical methods to derive content categories or dimensions from statistical analyses of word occurrence in a body of text. Borko (1965) used factor analysis to define a major classification of psychological research literature. Harway and Iker (1964) reported a similar methodological approach to the content

of therapy interviews. Although somewhat more objective than the *General Inquirer's* use of pre-established content categories, these methods demand a drastic preselection of the terms to be subjected to the factor-analytic process, and do not escape the limitations imposed by ignoring the syntax/context aspects of the data base.

Generally speaking, the difficulties encountered in this area have not been caused by the non-numerical nature of the raw data nearly as much as by the vagueness of available descriptions of the manner in which content analysis is accomplished. Computer progams have to be complete and totally objective, but no clinician is fully aware of the processes that lead him to his conclusions. Already, however, there are encouraging signs that interactions of various sorts between clinicians and programs (and programmers!) can produce clarifications of many once-obscure interpretive rules. The advantages of such clarifications for the training of psychologists are obvious, and are an often-overlooked side benefit of the research on computer-based assessment systems.

Statistical Prediction and Guidance

The use of computers to implement complex multivariate analyses of quantitative data was one of the earliest applications in the behavioral sciences, and is a routine part of research training in many universities today. Of particular interest are the applications of these techniques to problems involving prediction for individuals—optimization of decisions through equations based on normative expectations. Bottenberg and Ward (1963) have described the basic models for establishing such equations. Cooley (1964) has outlined the need and theoretical basis for a comprehensive system which employs computers and multivariate statistical analysis to enhance the guidance counseling of individuals. Bashaw (1965) described a system to optimize college selection by high school seniors, using multivariate statistics to make predictions from information about high schools and colleges, as well as the individual student.

In a somewhat different area, Page (1967) demonstrated that multivariate regression techniques could be used with simple counts of text characteristics to yield surprisingly efficient prediction of subjective grading of essays by human judges. Similar methods have been used to distinguish the writing of particular authors, and represent an alternative approach to direct content analysis of verbal materials.

Computer-Based Counseling Interviews

The recent advent of time-shared computer systems, that permit persons at remote terminals to engage in "conversational" interaction with computer programs, has made possible the exploration of what may prove to be a real boon to practicing counselor/psychologists. There are presently, in the United States, many computers equipped to operate on a time-sharing basis. Time-sharing systems can service stations that are physically far removed from the central computer; demonstrations have linked remote terminals across the country, and even to Europe (Loughary, 1966).

If the computer program is written to include a fund of knowledge

about various options open to the client, and is also designed to question him about his preferences, abilities, etc., with regard to the available options, the program could conceivably conduct most of the routine information-gathering and interviewing to which counselors now devote a good deal of valuable time. It is also likely that a small computer could be programmed to retrieve and dispense such data as efficiently as most counselors.

The actual development of software systems for these applications has only been underway for three or four years, but remarkable strides have already been made toward the goal of producing an efficient, comprehensive package system for small computers currently employed by school systems for other purposes, such as grade reporting and class scheduling.

We have already described Cogswell and Estavan's appraisal program for a student's cumulative folder (Cogswell & Estavan, 1965). This program preceded a planning interview with the student, which was also carried out by the computer. In preparation for this, recordings were made of actual counselors in planning interviews with students. These data were transcribed and analyzed and models of the counselor's responses during the interview were defined for computer simulation. Initially, using conventional computer-based programmed instruction techniques, the student was given a five-minute lesson on use of the teletype. Next, the student's cumulative folder was inspected and the machine typed out the student's courses and grades for the last semester and asked the student to indicate courses in which he was having problems. If he indicated problem courses, he was asked to type a description of the problem for each course. Plans of the student were explored in the interview, and finally, the student made a tentative program of courses for all three years of high school. Throughout the interview, records were kept by the program and, when certain critical events occurred, messages were composed and later sent to the counselor. In evaluating the effectiveness of the automated interview in a controlled study, it was found that when the schedules made by students under automated conditions differed from those made with the counselor present, those done with the computer were more often incomplete. In terms of attitude, a few students seemed to react very positively to the machine (making a strong point in favor of its confidentiality) while a few expressed a strong preference for the human counselor. The investigators felt that further study of the machine interview versus the counselor did not seem advisable, the more important question being to what extent automated interviewing could be integrated successfully into the counseling process (Cogswell, 1966; Loughary, et al., 1966; Hurst, 1967).

Starkweather (1965) also has written programs in which the computer takes the part of an interviewer, and can interact differentially to human responses. Like an interviewer who is interested in some kinds of information more than others, the computer searches the client's typed input for elements anticipated by the programmer; these words or phrases are the basis for a sequential decision process. Thus, what it types out at a particular point is determined in part by what it has just received. Early questions tend to be general, leading to more specific inquiry as the interview pro-

gresses. Specifically, answers to questions are compared against lists of words in different areas of psychiatric difficulty—e.g., use of the word "discouraged" by a client will cause branching to a subroutine of questions designed to elicit information about symptoms of depression. In initial testing, psychiatrists "role-played" the parts of actual patients they had recently seen and evaluated, and found the responses of the program generally appropriate. The program is unable to handle the responses of psychotic patients who give irrelevant answers, however.

The current programming is not felt by the investigators to have reached a level which would allow its use for actual information gathering from patients; it is seen rather as a teaching device. The programs are written in COMPUTEST, a language providing mechanisms for interactive programming, but also simple enough to avoid most details of computer operation. In an additional demonstration of the utility of this language, COMPUTEST was used in a research project in elementary education as an aid to developing pupils' skills in questioning and problem solving through programming efforts in a variety of subjects. After a brief discussion about the formal requirements of the language, third graders were able to develop a programmed test of 12 questions which appropriately processed the responses of their classmates.

Computer Simulation of Therapeutic Counseling

While Cogswell and Estavan's work dealt primarily with the assessment and guidance functions of counselor/psychologists, the work of Starkweather entered the area of therapeutic counseling. In a similar vein, Weizenbaum (1966) produced a program which makes a variety of transformations of the subject's language and attempts to simulate an interviewer of the school of Rogerian psychotherapy, as the following excerpt indicates. (The small letters represent the remarks of a young lady, the capital letters represent the machine.)

"men are all alike
IN WHAT WAY
they're always bugging us about something or other
CAN YOU THINK OF A SPECIFIC EXAMPLE
well, my boyfried made me come here
YOUR BOYFRIEND MADE YOU COME HERE
he noticed that I'm depressed much of the time
I AM SORRY TO HEAR YOU ARE DEPRESSED"

Weizenbaum's program, called ELIZA, contains a set of simple rules for finding the key word in the input and responding accordingly. If the program finds no key word, it can still respond "intelligently" by "marking time," and the memory can store a few statements for later use. Weizenbaum comments that ELIZA's principal objective may be considered to be the concealment of its lack of understanding. Colby (1966) has worked with an elaboration of this approach for the simulation of more extensive psychotherapy. In Weizenbaum's program, input sentences are scanned for keys; in Colby's system, the keys can be single characters or combinations

of words. The 1965 version of the program contained about 500 keys and 450 ways of responding. Recognition of a key by the program serves to (*a*) trigger a suitable response for the key; (*b*) substitute appropriate words in the response for those found in the input sentence; (*c*) identify and keep statistical track of important topics for the formulation of future responses. If input sentences contain no keys, they trigger responses which steer the subject back to previously mentioned topics, e.g., "Let's go back and talk further about your father." The program is designed to communicate an intent to help—to respond by questioning, clarifying, focusing, and occasionally interpreting. It attempts to keep the conversation going, to elicit information, and to utilize it.

Considering the depth of the problems encountered in this field, there is little chance that the human counselor will ever be supplanted by computer programs, but hopefully he will be able to devote himself more fully to the problems that cannot be routinely processed—the uniquely human situations for which he now has insufficient time. Computer programs provide rational information upon rational demand, and can even use rational methods to determine the information needed. When it comes to the irrational, intuitive, and emotional demands of therapeutic interaction, however, the machine is less effective than the human interviewer. Computers have not yet been programmed to reason by analogy, to sense subtle visual and auditory cues to emotion, or to feel empathically in a way that leads to understanding. They probably never will.

A Comprehensive Assessment-Counseling System

Within the next five years most school districts will own, lease, or have time-shared access to a medium or large scale computer system. By that time, the use of time-shared computer-assisted instruction in basic skills will be quite common in the larger systems. Any school which has converted its basic files in order to handle class scheduling, grade reporting, and attendance records by machine, and which has access to a time-shared computer, will probably be able to use one of the comprehensive assessment-counseling program packages which should be available within a few years. These projections are based on the very rapid pace of development in this field, excluding therapeutic applications.

Although the counseling/guidance literature does not always reflect the fact, the activities of school counselor/psychologists are presently dominated by the administration, scoring, and interpretation of tests. Routine testing of ability and achievement, grade recording and reporting, and filing for immediate-access retrieval can be handled at present where computer services are available, but this is not the case with intepretation of test-score profiles and grade patterns. Cooley (1964) used an interesting analogy to represent the kind of interpretive system that is needed in school settings. He compared present test-scoring and grade reports to the calibrated oil-pressure gauges that once were standard on automobile dashboards. Far more useful to the average driver is the now ubiquitous flashing red light that automatically comes on when the oil pressure gets too low. The point is not that school psychologists cannot interpret test-score profiles adequately,

but that an automatic warning system based on computer monitoring of the records would be a vast practical improvement. All too often the school psychologist has time to scan the files only for special cases *after* the problems have become so serious that they appear in the form of gross symptoms. An automated warning system could alert the psychologist to any subtle shifts in the ability/performance pattern in time to head off serious problems.

For convenience, the school counselor/psychologist of the future will probably have a computer terminal in his office. It would consist of a TV-like display screen and a keyboard for entering information and requests. Not only would the counselor receive reports periodically about students whose cumulative records show "red flag" conditions, he would also be able to obtain immediate display of a wide variety of information about any particular student, even during a counseling interview. Central records would contain not only grades and test results, but background data on physical and family characteristics, as well as records of any counseling the student had received from computer routines or from professionals.

If the school provided computer-assisted instruction in basic skills, students would be familiar with the use of computer terminals, and at least one general-purpose screen-and-keyboard unit would probably be provided for purposes other than instruction. Encyclopedic stores of general information might be on tap over phone links to regional service centers, and information-guidance programs would allow the student to explore conversationally the implications of his interests, abilities, and other resources with regard to selection of appropriate academic and vocational goals. The human counselor/psychologist would always be available for help beyond that provided by the computer system.

Although the actual conduct by computers of therapeutic counseling regarding personal problems is probably far in the future—if it can ever be achieved—the machine could conduct confidential precounseling exploratory assessment interviews, which would greatly speed and perhaps improve the eventual human interaction between counselor and client. The computer could present standard ambiguous stimuli, such as incomplete sentences, pictures, or even inkblots, and could conduct tailored inquiries based on the verbal responses of the subject. In such a system, parts of the interpretation might be fed back to the subject for clarification or confirmation, while other resulting data would be stored for later consideration by the psychologist prior to his first interview with the subject. In this manner, the computer could probably fulfill the major functions of a highly-trained psychometrist with a wide background of experience.

As the ratio of professional counselors to students continues to decrease during the next few years, the crushing demands by students for meaningful assistance in choosing among a widening array of more complex alternatives will demand the use of machine systems. Counselor/psychologists, now in the public schools, should be actively involved in planning computer systems for their institutions, to insure that those systems eventually will be able to provide the kinds of capability we have attempted to describe in this review.

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